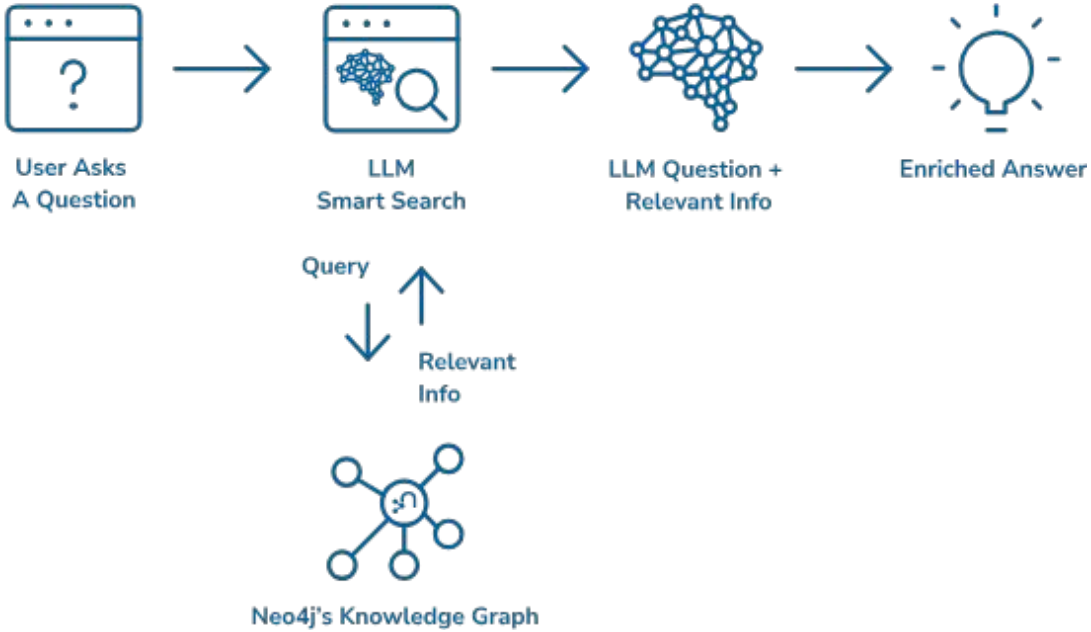
Going Meta #23: Advanced RAG patterns with Knowledge Graphs

in previous episodes…

RAG?

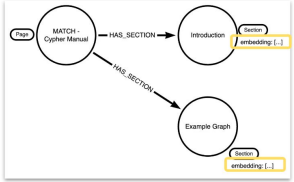


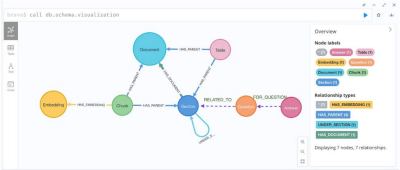
in previous episodes…

How do KG improve RAG?

Making retrieval **structure-aware**

https://medium.com/@yu-joshua/adding-structure-aware-retrieval-to-genai-stack-373976de14d6



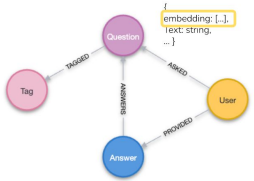


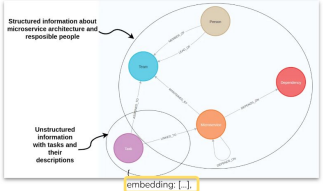
https://medium.com/neo4j/building-an-educational-chatbot-for-graphacademy-with-neo4j-f707c4ce311b

How do KG improve RAG?

Enabling **context augmentation**

https://bratanic-tomaz.medium.com/using-a-knowledge-graph-to-implement-a-devops-rag-application-b6ba24831b16





https://neo4j.com/developer-blog/genai-app-how-to-build/

Example1: Q&A on document with rich internal structure

STATUTORY INSTRUMENTS.

S.I. No. 516 of 2015

EUROPEAN UNION (DEPOSIT GUARANTEE SCHEMES)
REGULATIONS 2015

2 **[516]**

S.I. No. 516 of 2015

EUROPEAN UNION (DEPOSIT GUARANTEE SCHEMES)
REGULATIONS 2015

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S.I. No. 516 of 2015

EUROPEAN UNION (DEPOSIT GUARANTEE SCHEMES)
REGULATIONS 2015

I, MICHAEL NOONAN, Minister for Finance, in exercise of the powers conferred on me by section 3 of the European Communities Act 1972 (No. 27 of 1972) and for the purpose of giving full effect to Directive 2014/49/EU of the European Parliament and of the Council of 16 April 2014 on deposit guarantee schemes[1], hereby make the following regulations:

Part 1

PRELIMINARY AND GENERAL

Citation and commencement

1. (1) These Regulations may be cited as the European Union (Deposit Guarantee Schemes) Regulations 2015.

(2) These Regulations shall come into operation on 20 November 2015.

Scope

2. (1) These Regulations shall apply to the following:

(*a*) statutory deposit guarantee schemes;

(*b*) contractual deposit guarantee schemes that are officially recognised as deposit guarantee schemes in accordance with Regulation 8(1);

(*c*) institutional protection schemes that are officially recognised as deposit guarantee schemes in accordance with Regulation 8(2);

(*d*) credit institutions affiliated to the schemes referred to in subparagraph (*a*), (*b*) or (*c*).

(3) Without prejudice to Regulation 29(8), (9) and (12), the following schemes shall not be subject to these Regulations:

(*a*) contractual schemes that are not officially recognised as deposit guarantee schemes, including schemes that offer an additional protection to the coverage level laid down in Regulation 11(1);

(*b*) institutional protection schemes that are not officially recognised as deposit guarantee schemes.

"resolution authority" means the authority designated under Regulation 4(1) of the Bank Recovery and Resolution Regulations;

"target level" means the amount of available financial means which the deposit guarantee scheme is required to reach in accordance with Regulation 19 expressed as a percentage of covered deposits of its members;

"unavailable deposit" means a deposit that is due and payable but that has not been paid by a credit institution under the legal or contractual conditions applicable thereto, where either—

(*a*) the competent authority has determined that, for the time being, the credit institution concerned appears to be unable, for reasons which are directly related to its financial circumstances, to repay the deposit and has no current prospect of being able to do so,

[1] OJ No. L 331, 15.12.2010, p. 12

[516] 9

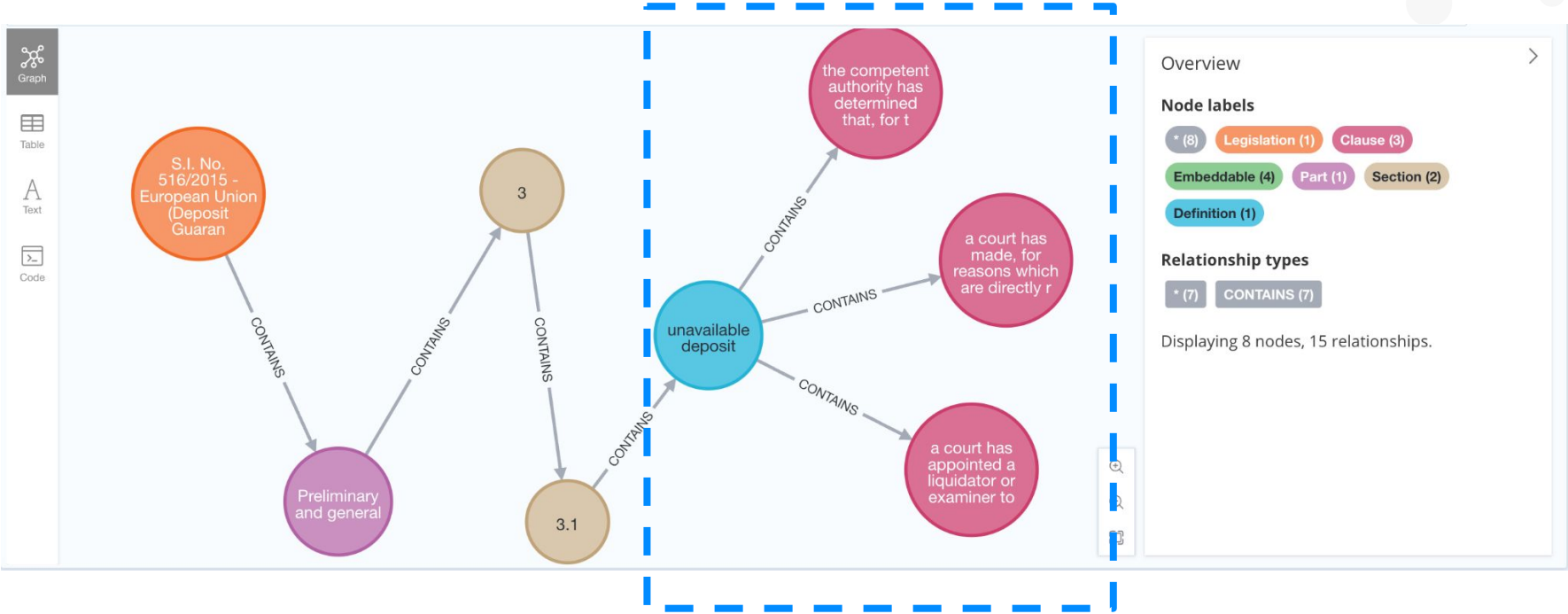
(*b*) a court has appointed a liquidator or examiner to the credit institution, or

(*c*) a court has made, for reasons which are directly related to the credit institution's financial circumstances, any other ruling that has the effect of suspending depositors' ability to make claims against it;

"Union Capital Requirements Regulation" means Regulation (EU) No 575/2013 of the European Parliament and of the Council of 26 June 2013 on prudential requirements for credit institutions and investment firms and amending Regulation (EU) No 648/2012[2];

https://www.irishstatutebook.ie/eli/2015/si/516/made/en/pdf

The document as a graph



Creating the embeddings and adding them to the vector index

```
from langchain.graphs import Neo4jGraph
from langchain.vectorstores.neo4j_vector import Neo4jVector
from langchain.embeddings.openai import OpenAIEmbeddings

vector_index = Neo4jVector.from_existing_graph(
    OpenAIEmbeddings(),
    url=url,
    username=username,
    password=password,
    index_name='legislation',
    node_label="Embeddable",
    text_node_properties=['definition', 'term', 'clause'],
    embedding_node_property='embedding',
)
```

There is also

`Neo4jVector.from_existing_index`

if the index is already created

Creating a RAG chain using the Neo4j Vector store

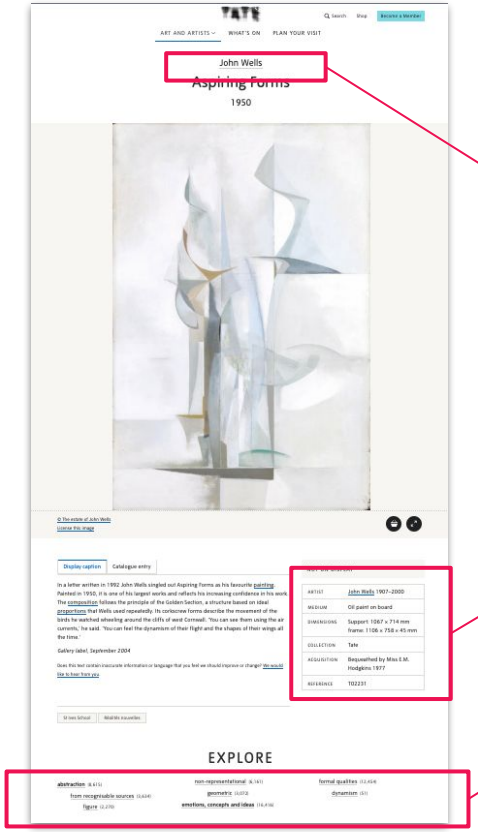
This chain will use exclusively the vector index

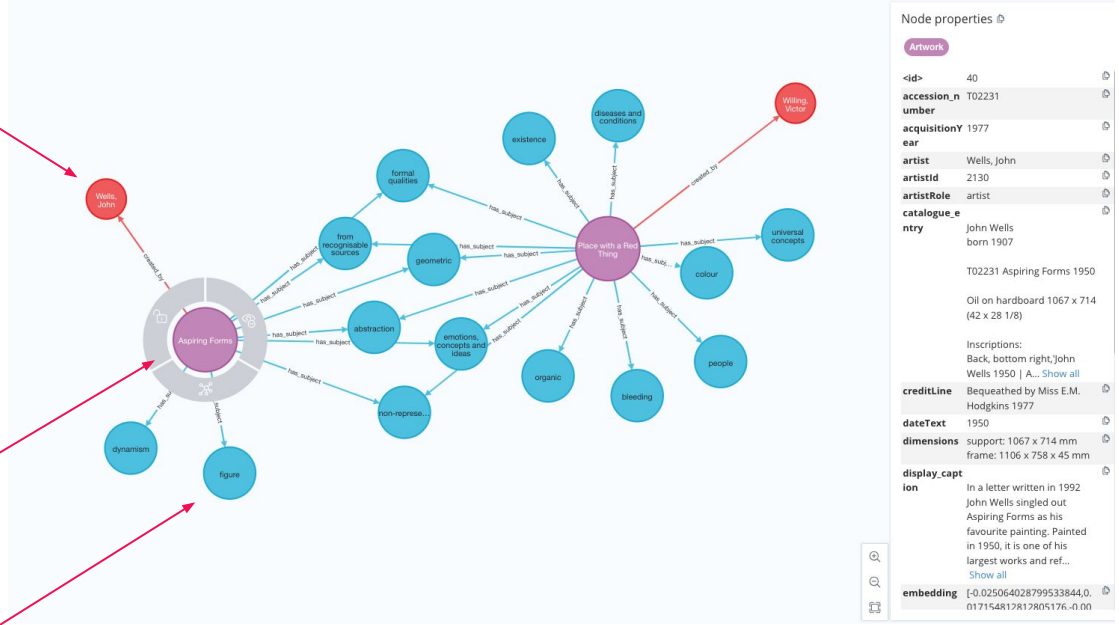
```
vector_qa = RetrievalQA.from_chain_type(
   llm=ChatOpenAI(), chain_type="stuff", retriever=vector_index.as_retriever())




vector_qa.run(question)
```

Injecting graph post-processing

```
contextualize_query = """
…cypher magic…
"""
contextualized_vectorstore = Neo4jVector.from_existing_index(
    OpenAIEmbeddings(),
    url=url,
    username=username,
    password=password,
    index_name="legislation",
    retrieval_query=contextualize_query,
)
```

Example 2: An art gallery assistant





https://www.tate.org.uk/art/artworks/wells-aspiring-forms-t02231

Email Generation Chain

```
llm = ChatOpenAI(temperature=0)
chain_app2 = ({'recArtworks': itemgetter('searchPrompt') |
RunnableLambda(kg_recommendations_app),
            'customerName': lambda x:x['customerName'],
            "searchPrompt":  lambda x:x['searchPrompt']}
           | prompt_app
           | llm
           | StrOutputParser())
```

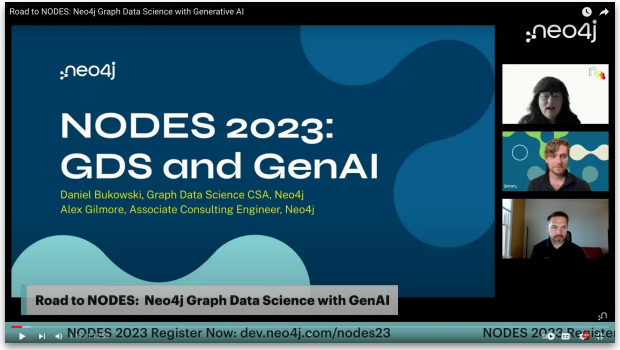
```
def kg_recommendations_app(input):
 response = contextualized_vectorstore.similarity_search(input, k=3)
 return "\n\n".join([d.page_content for d in response])
```

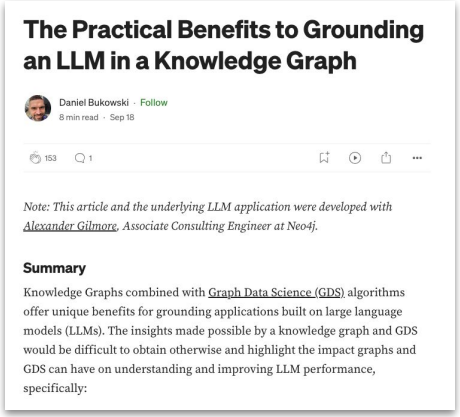
Prompt Definition

```
general_system_template_app = '''
You are a personal assistant for an art gallery.
write an email to {customerName}, one of your members, to plan their next visity to the gallery.
The email should summarize the artworks that match what they searched emphasizing on features and medium.
Introduce an art pun too based on the results!
Please only choose from the Artworks listed below. Do not come up with or add any new elements to the list.
Each artwork description comes with a "url" field.
Make sure to link to the url with descriptive name text for each artwork so the customer can easily find them.
---
# Relevant Artworks:
{recArtworks}
---
'''
general_user_template_app = '''{searchPrompt}'''
messages_app = [
   SystemMessagePromptTemplate.from_template(general_system_template_app),
   HumanMessagePromptTemplate.from_template(general_user_template_app),
]
prompt_app = ChatPromptTemplate.from_messages(messages_app)
```

What next?

https://www.youtube.com/watch?v=SUhM5SOYcd4





The Practical Benefits to Grounding an LLM in a Knowledge Graph

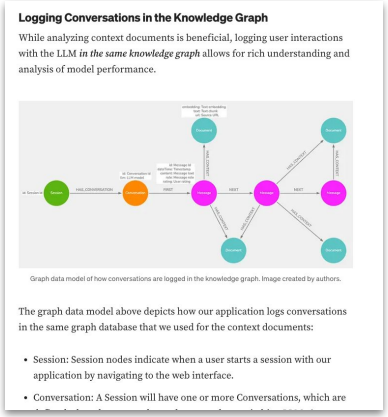
Daniel Bukowski · Follow
8 min read · Sep 18

153 1

Note: This article and the underlying LLM application were developed with Alexander Gilmore, Associate Consulting Engineer at Neo4j.

Summary

Knowledge Graphs combined with Graph Data Science (GDS) algorithms offer unique benefits for grounding applications built on large language models (LLMs). The insights made possible by a knowledge graph and GDS would be difficult to obtain otherwise and highlight the impact graphs and GDS can have on understanding and improving LLM performance, specifically:



Logging Conversations in the Knowledge Graph

While analyzing context documents is beneficial, logging user interactions with the LLM *in the same knowledge graph* allows for rich understanding and analysis of model performance.

Graph data model of how conversations are logged in the knowledge graph. Image created by authors.

The graph data model above depicts how our application logs conversations in the same graph database that we used for the context documents:

- Session: Session nodes indicate when a user starts a session with our application by navigating to the web interface.
- Conversation: A Session will have one or more Conversations, which are

https://medium.com/@bukowski.daniel/the-practical-benefits-to-grounding-an-llm-in-a-knowledge-graph-919918eb493